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Case Study of Integrating Mathematical Culture with the Course of Mathematics in Economics in Independent Colleges

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***Abstract*—In recent years, the term of "mathematical culture" has been used more and more frequently, and many colleges and universities across the country have also offered mathematical culture courses. Relevant cases relating to historical stories in mathematical culture, mathematical culture in daily life, philosophizing in mathematical culture, literature and art knowledge in mathematical culture, mathematical beauty and mathematical modeling thought integrated with the course of Mathematics in Economics teaching will be stated in this paper.**

Keywords*—*Mathematical culture; case; Mathematics in Economics

I. INTRODUCTION

In a narrow sense, mathematical culture refers to the ideas, methods, viewpoints, and spirits of mathematics and their formation and development; In a broad sense, in addition to the above contents, mathematical culture also includes the deeds of mathematicians, the history of mathematics, the beauty of mathematics, the humanities in the development of mathematics, the connection between mathematics and various cultures, the connection between mathematics and production and life, and so on. Therefore, mathematical culture is an important part of the curriculum of mathematics. To explain Mathematics in Economics without mathematical culture is not conducive to the improvement of students' mathematical literacy, and it will make the course boring and difficult to understand. In order to enable students to study Mathematics in Economics with their interest, and can understand the contained mathematical culture while learning and understanding some key knowledge points of Mathematics in Economics, and in order to improve their mathematical cultural literacy and make them pay attention to the study of mathematics in economics, it is necessary to study the mathematical culture cases of the course of Mathematics in Economics [1]. Compared with the students from key universities, the high school mathematics foundation of students from independent colleges is much weaker, and their learning autonomy and learning habits are much worse, and more than a half of them are liberal arts students. Therefore, it is particularly important to refer to the cases of mathematical culture in the teaching of Mathematics in Economics in independent colleges.

The teaching of Mathematics in Economics will be introduced in this paper from aspects such as historical stories in mathematical culture, mathematical culture contained in daily life, the philosophical thoughts in mathematical culture, literature and art knowledge in mathematics, and the aesthetic cases in mathematics.

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II. APPLYING HISTORICAL STORIES IN MATHEMATICAL CULTURE TO THE TEACHING PROCESS

The traditional teaching of Mathematics in Economics often underestimates the practical application of actual background and method, which easily separates the connection between mathematical theory and mathematical methods and the real world. Therefore, when introducing the generation and application of some mathematical concepts and mathematical methods, the historical stories in the development of mathematics should be properly interpreted alternately, clarifying the process by which mathematicians put forward problems, think problems and solve problems through examples of mathematicians who have made great achievements. The background of the generation of mathematical knowledge, the formation and development of mathematical concepts and the process of proposing mathematical theorems should be demonstrated to inspire students to understand the interaction between mathematics and social development [2], pursue the roots, and broaden their horizons, and to help students fully and profoundly understand mathematical knowledge.

For example, during the teaching of function, introduce the origin of the name of "function". In the textbook of Mathematics in Economics, "function" is usually defined as: suppose x and y are two variables, and D is a given nonempty set of number. If for each number $x \in D$, the variable y follows a certain corresponding law, and f always has a unique value corresponding to it, then y is called the function of x. However, the origin of the name of "function" is rarely mentioned. In fact, the name of "函数" (function) was translated for the first time by Shanlan LI, a mathematician at the end of the Qing Dynasty in China, when he translated the book of Algebra. "函"refers to a letter. When posting letters, envelopes are always needed, and the address of the recipient and the contact information should be written on the envelope, and the recipient of a letter is unique. Therefore, a letter that corresponds to a unique recipient is equated to an independent variable that corresponds to a unique dependent variable in the function. Thus, the name of "函数" (function) is introduced.

For another example, in the introduction of the concept of derivative, two classic examples of "the tangent slope of the curve at a certain point" and "the instantaneous speed of variable rectilinear motion" are usually introduced. But before that, the history of the development of derivative should also be briefly introduced. (1) Special forms of the early derivative concept. In the first half of the 17th century, Fermat used a small increment for tangent, and proposed a method for calculating the tangent curve in a manuscript, i.e. $\frac{f(A+E)-f(A)}{E}$ (2) The widely used "calculus of fluxion". Based on the previous creative research, mathematicians Newton and Leibniz systematically studied calculus from different angles. The calculus theory of Newton is called "calculus of fluxion". He referred to the variable as the flow, and the rate of change of the variable as the fluxion, which we call the derivative. (3) The theory of derivative theory that gradually matures. In the mid-18th century, D'Alembert proposed a viewpoint on the derivative, which can be simply expressed by modern symbols, $\frac{\mathrm{d}y}{\mathrm{d}x}=\lim_{\Delta x\to 0}\frac{\Delta y}{\Delta x}$, in the "differential" content of the fourth edition of the Encyclopedia published by the Académie des sciences. In the 19th century, Cauchy made a clear definition of derivative in his book The Tutorial of Introduction to Infinitesimal Calculations.

III. Applying the Mathematical Culture in Daily Life to the Teaching Process

Mathematics comes from life and serves life. Many basic concepts, theorems and formulas in mathematics have the source and background of real life, and have physical prototypes or expressions, which make mathematics and people's daily social life compatible and compatible. Mathematics and life can never be separated, since it has been integrated into all aspects of our life. If examples or phenomena in the daily life can be integrated into the knowledge of Mathematics in Economics, students' interest in learning will be greatly stimulated. For example, the vegetable price in the vegetable market is usually related to temperature and season. If the vegetable price can be expressed as a binary function of the two variables of temperature and season, then the partial derivative of these two variables is the rate of change (or trend) of vegetable price versus temperature and season. This is also the geometric meaning of partial derivatives.

IV. Applying Philosophizing to the Teaching Process

Mathematics is full of the dialectical relationship of philosophy, for example, constant and variable, finite and infinite, quantitative change and qualitative change, straight segment and curved segment, continuous and discontinuous, approximate and precise, etc. These philosophical dialectical relationships infiltrate into every concept of Mathematics in Economics.

On the basis of fully understanding these dialectical relationships contained in mathematics in economics, the content of mathematics in economics can be profoundly understood, and these dialectical relationships have their own unique form of expression in mathematics in economics, that is, use mathematical symbolic language and simple mathematical formulas to express various dialectical relationships and transformations. The following are some examples.

(1) Examples of sequences limitation. I. The problem of cutting off a stick. There is a sentence in Zhuangzi · The Society, that is, "a stick of one chi, cut off half of it every day, and it will not be finished even in ten thousand years", which means that there is a stick of one-chi long, if we cut off half of it every day, it will not be finished even in ten thousand years. For every specific day, the remaining length of the stick is present, but when the number of days increases indefinitely, the remaining length of the stick will be zero. This contains the philosophical dialectical relationship of finite and infinite, quantitative change and qualitative change. II. The technique of cutting circle. The ancient Chinese mathematicians Hui LIU and Chongzhi ZU used the "technique of cutting circle" to calculate the value of pi. π is taken as an inscribed regular polygon of a circle, and use the area of the inscribed regular polygon of the circle as an approximation of the area of the circle. When the number of inscribed regular polygon sides of a circle increases indefinitely, the area of the regular polygon can be equal to the area of the circle. That is to say, "when the number of inscribed regular polygon sides of a circle increases indefinitely, the area of the regular polygon can be equal to the area of the circle". Thus, the value of the pi is obtained. This contains the philosophical dialectical relationship of approximate and precise, and quantitative change and qualitative change. III. $3*0.\dot{3}=1$ According to the mathematics knowledge of primary school, we know that $\frac{1}{3}=0.\dot{3}$ multiply 3 on both sides of this equation, and we can get $3*\frac{1}{3}=3*0.\dot{3}$, and $3*\frac{1}{3}=1$, therefore, $3*0.\dot{3}=1$. According to the mathematical knowledge of primary school, it seems difficult for us to understand that this equation is true. However, we can easily understand it through limits. Because, when the number after decimal point is more and more, it will be closer and closer to 1. This is a process of quantitative change, but there is no qualitative change.Because $3*0.\dot{3}=0.\dot{9}$, when there is more infinity 9 after the decimal point , it will be "equal to" 1. This also contains the philosophical dialectical relationship of finite and infinite, and quantitative change and qualitative change.

(2) Area of the trapezoid with curved sides. In the cited example of definite integral and double integral, we will give the process of calculating the area of the trapezoid with curved sides and the volume of the curly top cylinder. In order to calculate the area of the trapezoid with curved sides, we divide it into several small ones. If the segmentation is small enough, we can approximately take the small trapezoid with curved sides as a small rectangle, thus we can use the rectangular area formula to calculate the approximate value of the area of each small trapezoid with curved sides, and the sum is the approximate value of the trapezoid with curved sides. Since what is obtained is the approximate value of the area, the

above-mentioned change process is only a process of quantitative change without qualitative leap. If the division is infinitely small, that is, the width of each small trapezoid with curved sides tends to be zero, the exact value of the area of the trapezoid with curved sides can be obtained, which makes a qualitative leap. This also contains the philosophical dialectical relationship of approximate and precise, and quantitative change and qualitative change. We can also use this relationship to understand the infinitesimal method of definite integrals to calculate area of plane figures and the volume of a solid when the area of a parallel section is given. For example, if we take $y = f(x)\left(x \in [a,b]\right)$ as the area of the trapezoid with curved sides (wherein $f(x) \in C[a,b]$ and $f(x) \geq 0$), we can understand the infinitesimal area of $f(x)\mathrm{d}x$ as the "area" of line segments with the height of $f(x)$, and width of $\mathrm{d}x$. And through the infinite accumulation of the area of the line segment (that is, the definite integral), it will become the area of the trapezoid with curved sides $\int_a^b f(x)\mathrm{d}x$. For another example, there is a solid, the cross-sectional area perpendicular to the axis x is a known continuous function $A(x)$, and the solid is located between the two planes $x = a$ and $x = b$ perpendicular to the axis. Its volume is $\int_a^b A(x)\mathrm{d}x$. We can also understand the infinitesimal volume $A(x)\mathrm{d}x$ as the "volume" of the thin section with the bottom area of $A(x)$, and the thickness of $\mathrm{d}x$, and through the infinite accumulation of the area of the thin section the volume of the sheet is infinitely accumulated (that is, the definite integral), it will become the volume of the solid $\int_a^b A(x)\mathrm{d}x$.

V. INFILTRATE LITERATURE AND ART KNOWLEDGE INTO THE TEACHING PROCESS

In the current textbook of Mathematics in Economics, traditional literature and art knowledge does not take an obvious position. However, the potential literary and artistic factors in Mathematics in Economics can be fully explored, and imperceptibly infiltrate the literature and art knowledge into the explanation of the knowledge of Mathematics in Economics.

For example, when talking about the limit, the poem of Farewell to Zongyi of Zongyuan LIU in the Tang Dynasty can be quoted, which says, "when I see Zongyi off at the riverside of Yuejiang, both of us shed tears. Thinking of I myself coming here that is so far away from the capital, suffering so much, I feel so lonely". The "I myself" here shows the loneliness and helplessness of the poet; "Suffering so much" shows the depth of the disaster. Qiji XIN, the lyric poet in the Southern Song Dynasty, in his Xijiangyue· Walking along Huangsha Road at Night, "seven or eight stars up above the world so high, two or three raindrops falling in front of the mountain. The old shop near the temple and the forest turned up after making a turn", the "seven or eight stars" and "two or three raindrops" are finite numbers, describing the vast sky with only a few stars, and the light rain is only a little bit.

For another example, when explaining some knowledge points, some words and expressions in the prose can be used to raise students' interest in the classroom. The discontinuous point of the function, "The reason that people are suffering lies in their pursuit of wrong things. The pursuit of wrong thing is that when you are infinitely close to it, you suddenly discover that you and it are not continuous". The convergence of the series, "Life is a series, while ideal is the value you are eager to converge. Our limited life can not describe the infinite series, and convergence is just a dream. So it is better to stand on solid ground, and strive to manage well every day".

VI. APPLYING MATHEMATICAL BEAUTY TO THE TEACHING PROCESS

Mathematics is a combination of rational thinking and imagination. Its development is based on the needs of society, so we have the mathematical beauty. It is mainly manifested in unity, symmetry, and simplicity.

There is no lack of beauty in mathematics, but in the teaching process, it is necessary to dig out the "mathematical beauty" that matches the content of the textbook, properly integrate the aesthetic content of mathematics, express the essence of mathematical beauty, and express the charm of mathematical beauty to make students experience the beauty, arouse their appreciation and pursuit of beauty, and guide them to appreciate and evaluate various mathematical beauty phenomena.

For example, when explaining a quadric surface, elliptical paraboloid, hyperboloid of one sheet, hyperboloid of two sheets, and hyperbolic paraboloid, all of which are symmetrical features, can be shown to the students, and pictures can be used to further introduce their actual application in architecture, for example, the tall and magnificent Sinosteel Building and simple and unadorned cooling towers, as well as the application of curved surfaces in art design.

VII. APPLYING MATHEMATICAL MODELING THOUGHT TO THE TEACHING PROCESS

Many models in finance and economics have a background of mathematics in economics, providing rich mathematical modeling materials for mathematics in economics. Many concepts of mathematics in economics, such as derivative, definite integral, and differential equation, some mathematical knowledge background and mathematical modeling thoughts and methods can be introduced in the teaching process of explaining the corresponding contents, which can inspire students to use mathematical knowledge to solve practical problems, and use mathematical methods to uncover the mysteries of problems and understand the universality of mathematics applications, thereby enhancing students' interest in learning, as well as enhancing their teamwork spirit.

For example, a distribution center distributes some domestic appliances to several supermarkets. It is assumed that the daily demand for such household appliances is stable, and the order fee is the same as the daily storage fee for each product. If the supermarket's demand for such living appliances is not out of stock, please develop the optimal storage model (i.e. how long does it take to order the goods, and how many goods are ordered each time).

VIII. CONCLUSION

Mathematical culture contains rich contents, and the mathematical culture cases of Mathematics in Economics also include all aspects. Students can be organized to read and collect information related to Mathematics in Economics in their spare time, and assignments should be submitted in small papers to motivate the learning initiative of students and make them participate in the process of discovering mathematical beauty and expressing mathematical beauty. At the same time, student's work materials should be added to the case set in student's vision.

In the teaching process, attention should be paid to the three factors of knowledge points, mathematical culture connotation and students' cognition to grasp the timing and depth of integrating into mathematical culture cases, and mathematical culture case cannot be introduced everywhere, nor the introduction of difficult mathematical culture cases. The cultural cases introduced should focus on the training of students' thinking, and at the same time, mathematical knowledge can be applied to real life to make students feel the value of mathematics, and train them to look at problems with mathematical visions, think problems with mathematical thinking, and solve problems with mathematical models.

In the teaching design process, priority shall be given to the knowledge of the textbook, while the integration of mathematical culture cases is to help students better understand the content of the textbook; and the introduced mathematics cases should not take too much time in the classroom teaching.

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